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Appendix C. Content Model--Mathematics--for Elementary Education.
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Descriptors-*Behavioral Objectives, Curriculum Guides, *Elementary School Mathematics, Elementary School Teachers, *Models, *Set Theory, Teacher Education, *Teacher Education Curriculum, Teaching Techniques
Identifiers-*ComField Model Teacher Education Program

This appendix charts the instructional manager's and the student's procedures for using the ComField Cognitive Model. Parts of the mathematical component of the ComField Model Teacher Education Program Specifications are then developed to complement these procedures. Ten mathematics topics (sets; numeration systems; numbers; basic operations; fractions, decimals, and percentages; algebra; geometry; graphs; problem solving; and measurement) for elementary school teachers are listed, and broad behavioral objectives are stated for each. As an example of the learning package that might be developed in order to teach mathematics to prospective teachers, the topic of sets is elaborated to include a set of specific behavioral objectives in teaching sets, a pretest for the first objective (introducing sets), material for a general introduction to sets, exercises in the use of sets, and a first posttest on the introduction to sets learning package. A 14-item bibliography is included. (This document and SP 002 155-SP 002 180 comprise the appendixes for the ComField Model Teacher Education Program Specifications in SP 002 154.) (SG)

APPENDIX C--CONTENT MODEL - MATHEMATICS - FOR ELEMENTARY EDUCATION

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RATIONALE FOR CONTENT MODEL

Performance of the specified competencies to criterion at the laboratory clinical level in prerequisite to initial certification in the ComField proposal. It is this thought that has provided the major thrust of Task Force II.

Once having identified the major topical areas of elementary modern mathematics, Task Force II stated broad behavoral objectives for each topic. This effort was followed by the statement of specific criterion performance objectives for each learner task within a major topical area. Specific criterion performance objectives range from lowest level cognitive to higher than lowest level cognitive objectives. Thus, the teacher-trainee knows precisely the content objective he is to undertake and the precise learning tasks involved in mastering that content.

Task Force II team members felt that the mastery of specific learning tasks should allow for a maximum of individual flexibility. Thus, the teacher-trainee is provided with a pretest for each criterion performance task, a variety of media to be utilized in overcoming diagnosed learner difficulties and a posttest to gauge learner progress throughout each major topical area. In keeping with the stated ComField goal that traditional emphasis on "knowledge" in teacher education be played down, Task Force II's criterion performance objectives are designed to assist the student to determine what he does and does not know. It is only by this process that the teacher-trainee can use these measures to develop application skill. Furthermore, it is expected that systematic training and assessment procedures follow the teacher trainee in all other areas of his preinternship training program.

It is with these thoughts in mind that this initial draft is submitted.

INSTRUCTIONAL MANAGER'S PROCEDURE FOR UTILIZING COMFIELD COGNITIVE MODEL

- Content Only -

List major topics within subject to be taught

see math topic model page 47

Develop broad behavioral objectives for each topic

see model page 48

Develop specific behavioral objectives for each topic

see model page 51

Develop pretest for each specific objective within each topic

see model page 57

Prepare learning packages for each specific objective:

Written learning packages
Audio learning packages
Visual learning packages
Audio and visual learning packages

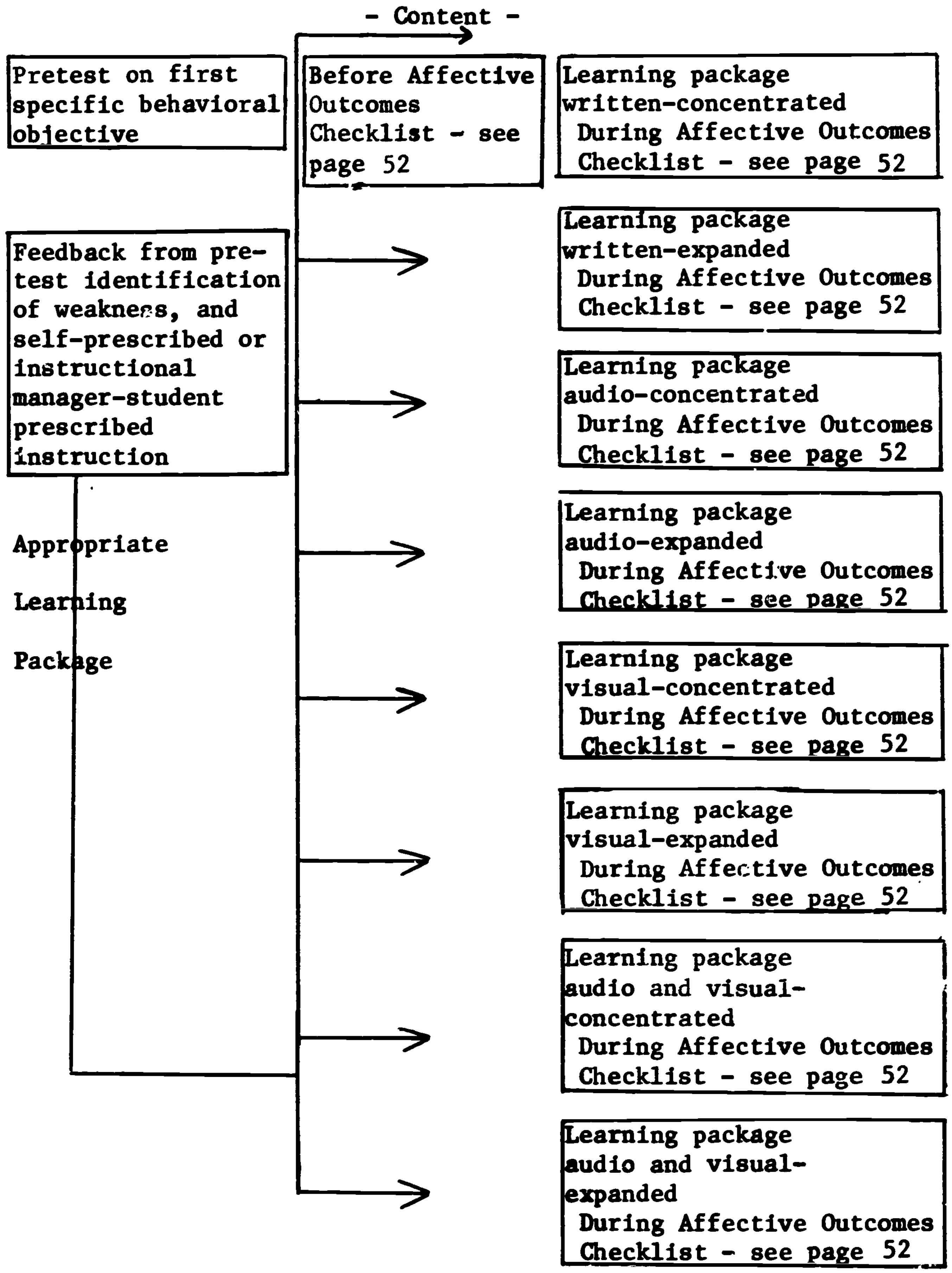
Concentrated and Expanded

see model page 58

Develop posttest on each specific objective

see model page 69

STUDENT PROCEDURE FOR UTILIZING COMFIELD COGNITIVE MODEL



Next pretest

After Affective Outcomes Checklist - see page 53

Posttest on first specific behavioral objective

Recycle

MATHEMATICS TOPICS FOR

ELEMENTARY TEACHERS

1. Sets
2. Numeration systems
3. Numbers
4. Basic operations
5. Fractions, decimals, and percentages
6. Algebra
7. Geometry
8. Graphs
9. Problem solving
10. Measurement

BROAD BEHAVIORAL

OBJECTIVES FOR MATHEMATICAL TOPICS

1. Sets:

Objective for student:

The student will: name and illustrate the classification of sets; name and describe the operations on sets; describe and illustrate the operations on numbers developed from sets; name, describe, and illustrate the properties of set operations; name and illustrate the use of set notation and symbolism; and describe and illustrate the application of sets.

2. Numeration systems:

Objectives for student:

The student will: select from a list of definitions the distinctive definitions of number and numeral; symbolically illustrate these differences; read and write decimal numerals, identifying place values; write any designated numeral in expanded notation; describe and illustrate exponents and exponential notation; illustrate, algorithmically, place value systems in other bases through the four basic processes; and narrate the historical development of numeration.

3. Numbers:

Objectives for student:

The student will: name the cardinal number which describes a given set of objects; count and name natural numbers; name and write whole numbers, decimal numbers, integer, fractional numbers, and irrational numbers; describe and name ordinal numbers and number sequences (such as ten's, two's, three's); define and name odd and even numbers; describe and illustrate the convention of rounded numbers; define and illustrate composite numbers; illustrate the processes of factoring composite numbers; demonstrate using the Sieve of Eratosthenes the identification of prime numbers through 97; and define, construct, and describe the uses of a number line.

4. Basic operations:

Objectives for student:

The student will, moving from concrete to abstract examples where applicable, with each of the basic operations and checks of addition, subtraction, multiplication, and division on whole numbers: name and describe using the correct vocabulary; the basic operations; perform the algorithm; explain the relationship between the four operations; recognize and prove commutative, associative, distributive, and closed properties of each, demonstrate each operation using number line, sets, and arrays when appropriate; explain and demonstrate the use of expanded and traditional notation on the operations of addition, subtraction, and multiplication; name and illustrate other societal methods of performing and checking the basic operations using slide rule and calculator.

5. Fractions, decimals, and percent:

Objectives for student:

The student will, moving from concrete to abstract examples where applicable, with fractions, decimals, and percents: identify and describe each using the correct vocabulary; perform the basic operations of addition, subtraction, multiplication, and division; recognize and prove commutative, associative, distributive, and closed properties of each; demonstrate mathematical estimation; perform basic operations using calculator; perform the operation of changing from one fractional system to another; perform the operation of factoring with fractions; discriminate and determine base, percentage, and percent; distinguish between terminating and repeating decimals through calculation; and determine by expanded notation the place values in decimal fractions.

6. Algebra:

Objectives for student:

The student will: translate English sentences into mathematical sentences; perform the basic operations on complex algebraic fractions; solve linear and simultaneous linear equations; explain and illustrate the concepts of modular arithmetic; explain and illustrate the simplification of algebraic expressions involving exponents through performing the correct basic operations; and explain and illustrate the concept of absolute value on a number line.

7. Geometry:

Objectives for the student:

The student will: name and illustrate using sets of points, curves, plane regions, and space figures; match formulas for area and volumes for plane regions and space figures; explain, using proper vocabulary, with concrete manipulative devices, when applicable, the derivation of formulas for plane regions and space figures, explain the likenesses and differences of quadrilaterals and use Venn Diagrams to depict these differences; name and illustrate different angles; construct, using protractors and/or compass, plane regions; use compass to bisect lines and angles; draw perpendicular and parallel lines using appropriate instruments; select correct formulas from a list of formulas and correctly solve given problems.

8 Graphs:

Objectives for student:

The student will: explain and construct coordinate systems using one or two coordinate lines; explain and construct bar, line, and circle graphs; graph linear equations; and graph collected data.

9. Problem solving:

Objectives for student:

The student will: illustrate geometrically, where appropriate, English sentences; translate English sentences into mathematical sentences and conversely translate mathematical sentences into English sentences; determine solution sets for mathematical sentences; and match estimated with solution sets.

10. Measurement:

Objectives for student:

The student will: perform the basic operations on denominate numbers; measure and calculate distances, areas, and volumes; and explain and illustrate the fundamental properties of measurement, i.e., nonnegative symmetry, triangular inequality, and additive.

Specific Behavioral Objectives for Mathematic Topics

For Elementary Education

1. Sets

Objective for the student:

The student will: name and illustrate the classification of sets; name and describe the operations of sets; describe and illustrate the operations on numbers developed from sets; name, describe and illustrate the properties of set operations; name and illustrate the use of set notation and symbolism; and describe and illustrate the application of sets.

A. Given a list of the following mathematical terms and symbols the student will in 100 percent of the cases match the term or symbol with the correct illustrations: (1) set; (2) elements or members of set as identified by rule, as identified by naming, as identified by element membership; (3) kinds of sets including equal or identical sets, equivalent sets, nonequivalent sets, null or empty sets, finite set, infinite set, universal set, disjoint set, intersecting or overlapping set, and (4) subsets including improper subsets and proper subsets.

B. Given a list of the following mathematical terms and Venn Diagrams to illustrate each the student will in 100 percent of the cases match the term with its correct Venn Diagram.

C. The student will verbally define and provide both illustrative examples from the immediate environment and by the use of Venn Diagrams the following: (1) set; (2) elements or members of sets as identified by rule, as identified by element membership; kinds of sets including equal or identical sets, equivalent sets, nonequivalent sets, null or empty set, finite set, infinite set, universal set, disjoint set, intersecting or overlapping set, and subset including proper and improper subsets.

D. Given disjoint sets, the student will perform, without error the operations of intersections and union of these disjoint sets using:

(1) the appropriate Venn Diagrams as illustrative proof
(2) set notation as an illustrative proof

E. Given concrete sets students will match or map different sets to one another and in each case select without error those that are in one-to-one correspondence.

F. After given the concept of cardinal numbers and given Set A, comprised of any variety of elements and Set B, comprised of the counting numbers the student shall demonstrate in writing by one-to-one correspondence between the elements of Set A and Set B, the correct cardinal number of Set A in each of five consecutive cases.

G. To describe and illustrate operations and properties of numbers developed from sets:

1. Given Set A and Set B, the student shall, in five of five cases, unite Set A and Set B and identify by writing the name of the elements contained in the union of Sets A and B.

2. Given the rule governing the union of sets, the student will apply that rule to the union of X number of sets and correctly list the elements contained in the union.

3. Given Set A and Set B, the student shall depict by correct Venn Diagram, the union of Set A and Set B in a minimum of five consecutive cases.

4. Given the rule governing the union of sets, the student will apply that rule to X number of sets and will construct the correct Venn Diagram in five of five cases.

5. Given Set A and Set B, the student shall, in five of five cases, demonstrate in writing the intersection of sets and identify by name the elements that intersect.

6. Given the rule governing intersection of sets, the student will apply that rule to the intersection of X number of sets and in five of five cases correctly list the elements that intersect.

7. Given Set A and Set B, the student shall depict, using a correct Venn Diagram, the elements of the intersection of Set A and Set B in five consecutive cases.

8. Given an example of the commutative property of sets, the student shall demonstrate using correct set notation, that the union of sets is commutative in a minimum of five out of five cases.

9. Given an example of the commutative property of sets, the student shall demonstrate using Venn Diagrams, that the union of sets is commutative in a minimum of five out of five cases.

10. Given an example of the commutative property of sets A and B, the student shall write, using correct set notation, that the intersection of Sets A and B is commutative in a minimum of five consecutive cases.

11. Given an example of the commutative property of Sets A and B, the student shall correctly depict, using Venn Diagrams, that the intersection of sets is commutative in a minimum of five consecutive cases.

12. Given an example of the associative property of sets the student shall in five of five cases list the elements using correct set notation to demonstrate that the union of sets is associative.

13. Given an example of the associative property of sets the student shall in five of five cases using correct Venn Diagrams demonstrate that the union of sets is associative.

14. Given an example of the associative property of sets the student shall in five of five cases list the elements using correct set notation to demonstrate that the intersection of sets is associative.

15. Given an example of the associative property of sets the student shall in five of five cases using correct Venn Diagrams demonstrate that the intersection of sets is associative.

H. To name and illustrate the use of set notation and symbolism:

1. Given a set composed of X elements, the student will correctly name and correctly notate the elements of X set in five of five cases.

2. Given a set composed of X elements, the student will correctly name and correctly notate the subsets of set X in five of five cases.

3. Given a set composed of X elements, the student will correctly name and correctly notate the cardinal number of set X in five of five cases.

4. Given Set A and Set B, the student will correctly name and correctly notate the cardinal number of each set and solve for union of Set A and Set B using correct cardinal number and correct set notation in five of five cases.

5. Give Set A and Set B, the student will correctly name and correctly notate the cardinal number of each set and solve for the intersection of Set A and Set B using correct cardinal number and correct set notation in five of five cases.

6. Given the definition of an infinite set the student will correctly notate infinite sets in five of five cases.

7. Given the definition of finite sets, the student will correctly notate finite sets in five of five cases.

8. Given five examples of equal sets, the student will correctly notate the equal sets in each of five cases.

9. Given five examples of nonequal sets, the student will correctly notate the nonequal sets in each of five cases.

10. Given five examples of nonequivalent sets the student will corectly notate the nonequivalent sets in each of five cases.

11. Given five examples of equivalent sets, the student will correctly notate the equivalent sets in each of five cases.

12. Given X examples of equal and nonequal sets, equivalent sets, the student shall correctly notate the correct relationship between sets in 100 percent of the cases.

13. Given the terms "greater than" and "less than" the student shall in 100 percent of X cases compare and correctly notate using "greater than" and "less than" the relationship between the sets.

14. Given the terms "greater than or equal to" and "less than or equal to" and their symbols the student shall in five of five cases compare and correctly notate using "greater than or equal to" and "less than or equal to" the relationship between X sets.

15. Given X number of sets the student will correctly notate in 100 percent of the cases the relationships of $<$ or $>$ or $\geq$ or $\leq$ between the sets.

I. Given the rule for operation and properties of set, the student shall demonstrate his ability to solve X number of problems:

1. The student shall demonstrate his ability to correctly select and construct problems for intersection of sets, union of sets, equivalency of sets, nonequivalency of sets, finite sets, infinite sets, universal sets, disjoint sets, proper and improper subsets and elements of sets.

2. The student shall correctly select and use Venn Diagrams to demonstrate his ability to construct problems involving the union and intersection of sets.

3. The student shall demonstrate his ability to correctly select and correctly construct problems for $<$, $>$, $\geq$ and $\leq$.

Pretest on Sets - Objective A

1. Set
2. Elements or Members of a Set
3. Equal or Identical Sets
4. Equivalent Sets
5. Equal and Equivalent Sets
6. Nonequivalent Sets
7. Universal Sets
8. Subset
9. Null or Empty Set
10. Finite Set
11. Infinite Set
12. Disjoint Set
13. Intersecting Sets
14. Improper Subset
15. Proper Subset

A. All the people in Chicago

B. $A = \{\ \}$

C. All the cows on the moon

D. $A = \{1, 2, 3, 5\}$
$B = \{\triangle, \square, \times\}$
$A = \leftrightarrow B$

E. $N = \{54, 56, 58 \ldots 100\}$

F. $C = \{2, 4, 6\}$ $\quad C = D$
$D = \{6, 2, 4\}$

G. $A = \{B, C, D\}$
$B \in$ Set A

H. Family

I. $N = \{1, 2, 3 \ldots\}$

J. A {All people in Chicago}
B {All married men in Chicago}

K. $A = \{1, 2\}$
$\{1\} \subset A$

L. $A = \{3, 4, 5\}$
$B = \{6, 7\}$
$A \cap B = \{\ \}$

M. $A = \{\circ\ \square\}$
$B = \{11, 2\}$
$A \leftrightarrow B$

N. $A = \{1, 2\}$
$\{1, 2\} \subset A$

O. $A = \{3, 5, 7\}$
$B = \{2, 4, 8\}$

P. $A = \{2, 4, 8, 11, 15\}$
$B = \{3, 4, 11, 12, 13\}$
$A \cap B = \{4, 11\}$

Sets
Learning Package
WPC #1

AN INTRODUCTION TO SETS

One of the most original topics in the modern elementary school mathematics curriculum is that of sets. It is the purpose of this unit to develop some simple concepts concerning sets and operations on sets.

SETS

A set may be described as a collection of concrete or abstract entities. It may consist o.̃ a collection of objects, persons, animals, letters, numbers, etc. The items which make up a set are called the <u>members</u> or the <u>elements</u> of the set.

Examples of sets are: a family; a class; a team of basketball players; the numbers greater than 10 and less than 20.

A capital letter is usually used to designate a set. A set is tabulated as follows: A = $\{1, 3, 5, 7, 9\}$. This sentence is read "A is the set whose members are 1, 3, 5, 7, 9" or "A is the set of odd numbers from 1 through 9." Note that the names of the elements of the set are listed between braces.

The cardinal number of a set tells us how many elements are contained in the set. If A = $\{\triangle, \square, \bigcirc\}$; then its elements can be placed in a one-to-one correspondence with those of set $\{1, 2, 3\}$, and we say that its cardinal number is three. This may be expressed as n(A) = 3, which is read "The number of Set A is three." Observe that the last member of $\{1, 2, 3\}$ indicates the number of elements in the set and is the cardinal number of the set. Similarly, if B = a, b, c, d, e, its elements can be paired with the members of the set $\{1, 2, 3, 4, 5\}$, and we write n(B) = S.

THE EMPTY SET

The empty set has no members at all. For example, there are no members in the set made up of the states of our country the names of which begin with the letter Z. The <u>empty set</u> is also called the <u>null set</u>. The symbol for the empty set is $\emptyset$. The empty set may be tabulated as follows: A = $\{\ \}$. The cardinal number of set A is zero. Thus n(A) = 0.

FINITE SETS

If we can assign a natural number as a cardinal number to the total number of elements in a set, the set is called a finite set. Some finite sets have so many elements, however, that to tabulate their names would be impractical. Generally, such sets have some pattern to their elements and, once this pattern has been indicated, three dots are used to denote continuation of the pattern with the last element named to identify the end of the pattern. Thus N = $\{2, 4, 6 \ldots 40\}$ expresses the set of even integers from 2 to 40.

INFINITE SETS

If a set is not finite it is an <u>infinite set</u>. The number of members in an infinite set is endless. Examples of infinite sets are: the set of natural numbers; the set of even numbers; the set of points on a line.

The set of natural numbers is tabulated as follows: N = $\{1, 2, 3, \ldots\}$. This sentence is read "N is the set of natural numbers 1, 2, 3, and so on infinitely."

EQUAL SETS

If A and B are sets which have precisely the same members, then A and B are said to be equal sets. Thus, if A and B are equal sets, then every element of A is an element of B and vice versa. We write A = B. In designating the elements of a set, each object should be named once and only once. The order in which the elements are listed is immaterial.

<u>Example 1</u>: Let A represent all the books in John's library, and let B represent all the arithmetic books John has. John has only arithmetic books.

A = {the books in John's library} .
B = {John's arithmetic books} .
A = B

<u>Example 2</u>: Let A represent all the odd numbers between 2 and 8, and let B represent all the prime numbers between 2 and 8.

$A = \{3, 5, 7\}$.
$B = \{3, 5, 7\}$.
$A = B$

If two sets C and D are not equal we write: $C \neq D$.

EQUIVALENT SETS

If the ele..ents in one set can be placed in a one-to-one correspondence with another set (that is, if for each member of one set there is one and only one member of the other set and vice versa) the sets are said to be equivalent sets.

Example: A = {Bill, Ray, George} .
B = {milk, water, tea} .

A is equivalent to B since the two sets can be matched. This means that members of the sets can be placed in a one-to-one correspondence as follows:

A = {Bill, Ray, George}

B = {milk, water, tea}

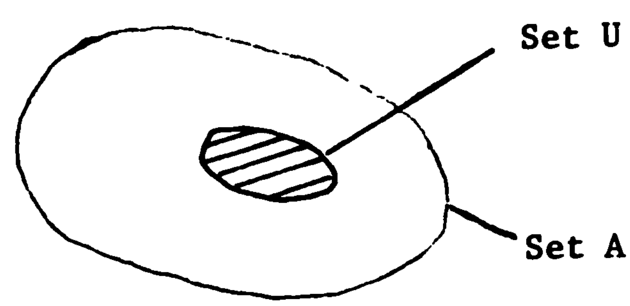
We write A $\leftrightarrow$ B.

Two equal sets are always equivalent since they can be matched. If A = {3, 5, 7} , and B = {5, 3, 7} , then A and B are equal and equivalent.

Two equivalent sets are not necessarily equal. If C = {Dick, Tom, Harry} , and D = {train, car, bus} , then C and D are equivalent since there is a one-to-one correspondence between elements of the sets. C and D are not equal since all members are not common to both sets.

If two sets E and F are not equivalent we write E $\not\leftrightarrow$ F.

THE UNIVERSAL SET AND SUBSETS



Consider the following example.

U = {all people in New York City} .
A = {All men in New York City} .

This universal set and the subset can be represented in a diagram:

Set A is contained in set U and is called a subset of the universal set U. We write A$\subset$U. This sentence is read "A is a subset of U." The set from which the subsets are derived is called the universe or the universal set. Examples of other subsets which can be drawn from the universe expressed above are: the set of all women in New York City, the set of all men above

20 years of age in New York City, etc. Hence, a subset of a set U, is any set whose members are members of U. Observe that the empty set is also a subset of the universal set. Note furthermore that a set is a subset of itself.

Example: Set C = $\{1, 2, 3\}$. Subsets of C are: $\{1\}$ $\{1, 2\}$ $\{1, 2, 3\}$
$\{2\}$ $\{2, 3\}$
$\{3\}$ $\{1, 3\}$

Set C has 8 subsets.

A set with 3 elements has $2^3 = 8$ subsets. A set with 4 elements has $2^4 = 16$ subsets.

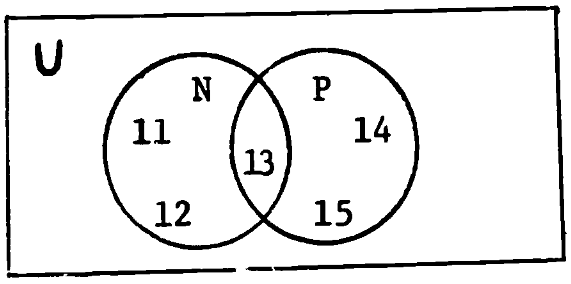
A set with n elements has 2^n subsets.

Kramer, Klaas, Mathematics for the Elementary School Teacher, Allyn and Bacon, Inc. 1965.

8. U = (1, 2, 3, . . .).
N = (11, 12, 13).
P = (13, 14, 15).

N ∪ P = ____________

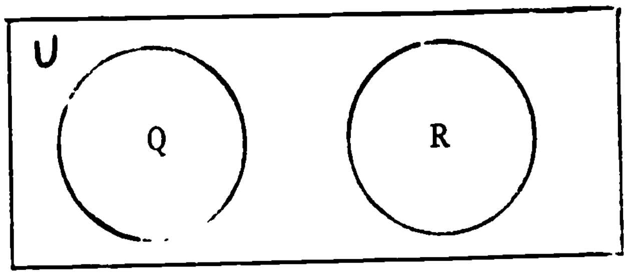
N ∩ P = ____________



9. U = (1, 2, 3, . . .).
Q = (10, 11, 12, 13, 14).
R = (20, 21, 22, 23, 24, 25).

Q and R are called

____________________ sets.



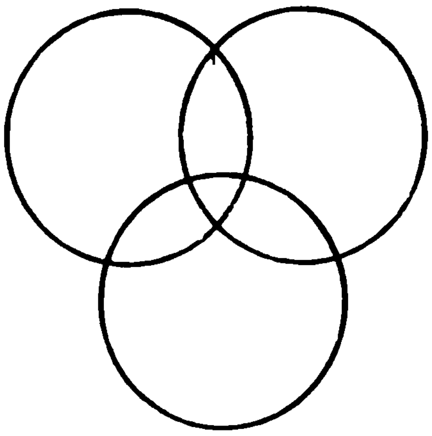
10. Solve the following problem by using sets and a Venn diagram.

In the sixth grade of Madison School there are three clubs: (1) the mathematics club; (2) the science club; and (3) the reading club.

12 pupils are members of the mathematics club.
11 pupils are members of the science club.
15 pupils are members of the reading club.
2 pupils are members of the mathematics club and of the science club.
1 pupil is a member of the mathematics club and of the reading club.
3 pupils are members of the science club and of the reading club.
5 pupils are members of the mathematics club, of the science club, and of the reading club.

How many pupils are members of one or more of these three clubs?

EXERCISE SET III - 5



_______pupils are members of only the mathematics club.

_______pupils are members of only the science club.

_______pupils are members of only the reading club.

_______pupils are members of the mathematics club and of the science club.

_______pupils are members of the mathematics club and of the reading club.

_______pupils are members of the science club and of of the reading club.

_______pupils are members of the mathematics club, the science club and the reading club.

_______pupils are members of one or more of the three clubs.

Kramer, Klaas, Mathematics for the Elementary School Teacher, Allyn and Bacon, Inc. 1965.

WPC #1

Examples of L. C. (Learning Checks) for WPC #1

<u>Assignments</u>

1. Knowledge

   Set A = $\{a, b, c, d\}$

   a. A is the symbol naming the ______________.

   b. $\{a, b, c\}$ are (is) (a) elements, (b) a subset, (c) disjoint, (d) a and b, (e) none of these in Set A.

   c. Describe in words Set A.

2. Comprehension

   a. Write, using set notation, the following sentence: All presidents of the United States who have been over ten feet tall.

   b. In your own words write your interpretation of $n(A) = 3$.

Responses to these items could be taped, written or partly taped and written.

3. Application

a. Betty and Jim belong to both the Drama and the Glee Club. The Glee Club has eight other members who belong only to it while the Drama Club has ten other members who belong only to it. Betty and Jim are members of a committee planning a joint party. They plan on going to dinner at a local cafe. How many dinners should they order for the club members? Show your work using Venn diagrams.

b. Halley, Pete, Joe, Ruth, Jim and Ann have little brothers while Mabel, Jack, Halley, Ruth, Jim and Kevin have younger sisters. How many tickets to the show, Mickey Mouse, should be ordered if the older brothers and sisters want to send their younger brothers and sisters to the show while they shop? Find your solution by using set notation and by using Venn diagrams.

ANALYSIS

Set A contains all the cars made in the United States that have six cylinders. Set B is a set composed of all the cars made by Ford Motor Company in 1967. Set C is made up of all the cars in the United States that are painted green. Set D is all the cars in the United States that have automatic transmissions. What is the set relationships that exist between these four sets? Explain in writing your logic for distinguishing your relationships.

SYNTHESIS (abstract relations)

a. Draw a Venn Diagram showing the relationship between the following quadrilaterals, rhombus, rectangles, parallelograms, squares, trapezoids, all other quadrilaterals.

b. There are several subsets of numbers that comprise our set of real numbers (whole, zero, counting, rational, integers irrational, fractions). Invent or produce a graphic or a diagram that will display the relationship that exists between them.

Sets
Learning Package
WPE #1

Directions:

Study the following assignment and complete each exercise set. Repeat each exercise set until proficiency is achieved.

Assignment:

Units 2, 3, 4.

Source:

Heddens, James W., Today's Mathematics: A Guide to Concepts and Methods in Elementary School Mathematics, S. R. A., 1964.

Sets
Learning Package
AVE #1

Directions:

View the film listed below. Give two examples of each of the following terms: set; elements or members of set as identified by rule, as identified by naming, as identified by element membership; equal or identical sets, equivalent sets, non-equivalent sets, null or empty set, finite set, infinite set, universal set, disjoint set, intersecting set; and subsets.

Source:

Film: "Sets, Numbers, and Numerals," 29 min., SRA. 1962

FIRST POSTTEST: AN INTRODUCTION TO SETS
(Knowledge)

1. Disjoint Set
2. Improper Subset
3. Infinite Set
4. Subset
5. Equal Set
6. Universal Set
7. Intersecting Sets
8. Nonequivalent Sets
9. Null Set
10. Finite Set
11. Proper Subset
12. Equivalent Set
13. Elements or Members of a Set
14. Empty Set
15. Set

A. All the animals in Brookfield Zoo

B. $X = \{\ \}$

C. $X = \{10, 12, 14 \ldots 50\}$

D. $A = \{2, 4, 8\}$
$\{2, 4\} \subset A$

E. $I = \{A\ C\ F\}$
$J = \{C\ A\ F\}$

F. $A = \{1, \square\}$ $1 \in A$
$\square \in A$

G. 10 file folders

H. $N = \{10, 11, 12 \ldots\}$

I. All monkeys in Brookfield Zoo

J. $A = \{a, b,\}$, $B = \{1, 2\}$
$A \leftrightarrow B$

K. $X = 6, 7, 8$
$Y = 9, 10$

L. $X = Y$

M. Six light fixtures in a classroom

N. $Y = \{6, 8, 10\}$
$X = \{5, 7, 9\}$

O. $X = 3, 5, 7, 9, 11$
$Y = 1, 5, 6, 7$
$A \cap B = 5, 7$

P. $A = \{1, 2, 3\}$
$B = \{3, 2, 1\}$
$B \in A$

Q. $0 = \{1, 2, 3, ...\}$

R. A hockey team

S. $B = \{N, R, B\}$
$0 = \{M, 0, Z\}$

T. $P = \{ \}$

U. $N = \{30, 40, 50\}$
$0 = \{60, 70\}$

V. D = P X O L
E = K R X L
$D \cap E$ = XL

W. 0 = P

X. All states whose names begin with the letter A

Y. $A = \{1, 2\}$, $B = \{c, d\}$, $A \neq B$

Z. $C = \{1, 2\}$, $B = \{2, 6\}$,
$C \cap B = 2$

AA. $R = \{20, 30, 40 ... 100\}$

BB. $A = \{1, 2\}$, $B = \{2, 1\}$, $A = B$

CC. $C = \{1, 2, 3 ..\}$

DD. All states of the United States

APPENDIX C

Model for Teaching Strategies of Teaching

s

S_1

*C.O. + A = 1.0 $\longrightarrow$ S_2 $\longrightarrow$ E. L.

S_3

*Content objective plus audience equals instruction objective; the instructional objective with the catalyst of the proper teaching strategies brings effective learning.

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